WARM-UP A

PREDICTION

This exercise lets students practice making predictions, experimenting to test their hypotheses, and refining their predictions based on the results. It can be used with the activities called “Finding Sources of Air Pollution” and “Climate and the Greenhouse Effect,” which include use of prediction skills.

CRITICAL OBJECTIVES

- Recognize role of predictions in science
- Refine predictions based on observation and experimentation
- Test hypotheses

SKILLS

- Forming and refining predictions
- Observing
- Comparing
- Interpreting and using results

GUEST PRESENTERS

Guest presenters for this exercise could include atmospheric scientists, environmental scientists, EPA environmental protection specialists, or meteorologists.

BACKGROUND

Making predictions and developing theories are central to the scientific method. History is replete with examples of scentists using their imagiNations and sound logic to hypothesize explaNations for things they observed and predict what should, or could, come next. While scientific predictions generally speculate about future observations or events, they also can focus on the past. For example, scientists may use observations from the present to predict where evidence related to the origins of humans might be found.

Environmental scientists and others use data collected in a variety of different experiments to examine trends and changes in the atmosphere and air quality. Using their observations and data from these experiments, they can predict, for example, whether the Earth’s temperature is warming or cooling, what conditions will influence these changes, and how long it will take for each increase or decrease in temperature to occur.

There is always some uncertainty involved in making such predictions, because we still do not know everything about how individual

RELATED ACTIVITIES
9,13

REFER TO READING MATERIAL
“Weather and Air Quality”

TARGET GRADE LEVEL
5th - 8th

DURATION
45 minutes

VOCABULARY
Hypothesis
Precursor
Prediction
Variable

MATERIALS
Current day’s newspaper
Three 12-oz. glasses
An 8-oz. plastic or styrofoam container (small enough to fit inside one of the glasses)
Tray of ice cubes
Chalkboard
Graph paper
Pencils

environmental processes work, much less how they interact. But the process of making predictions is important because it helps us gain more knowledge about unobserved phenomena and potential problems. (For example, predictions enable local government officials to warn health authorities and the public of the potential for conditions, like air inversions and smog, that could be harmful to people with respiratory difficulties and advise them how to protect themselves.)

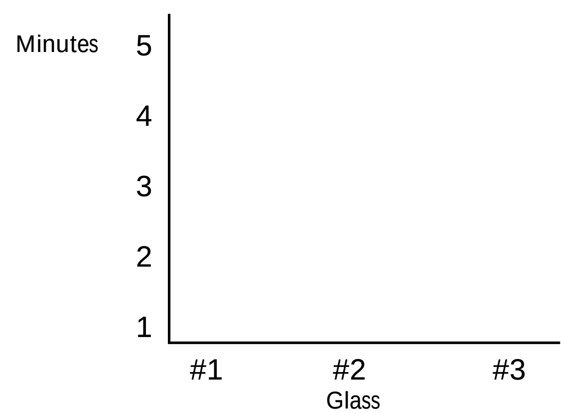
The ability to make predictions like these has been honed over time by continuously testing predictions and hypotheses and revising them based on observed results. It is through this process, for example, that scientists have been able to identify specific variables in the weather (called "precursors") that signal the formation of smog. (See reading material on "Weather and Air Quality.")

WHAT TO DO

1. Ask the class why we would want to know what will happen tomorrow? Let students give their answers. Try to have them analyze and group their answers by category. For example, which answers have to do with "feeling secure"? How many relate to "being in control" or "being able to plan"? (This serves to illustrate the significance of the process of prediction.)

2. Hold up today's newspaper. Read the local weather forecast, including the information on air quality. Ask students how they think forecasters decide what to predict? What do they base their predictions on?

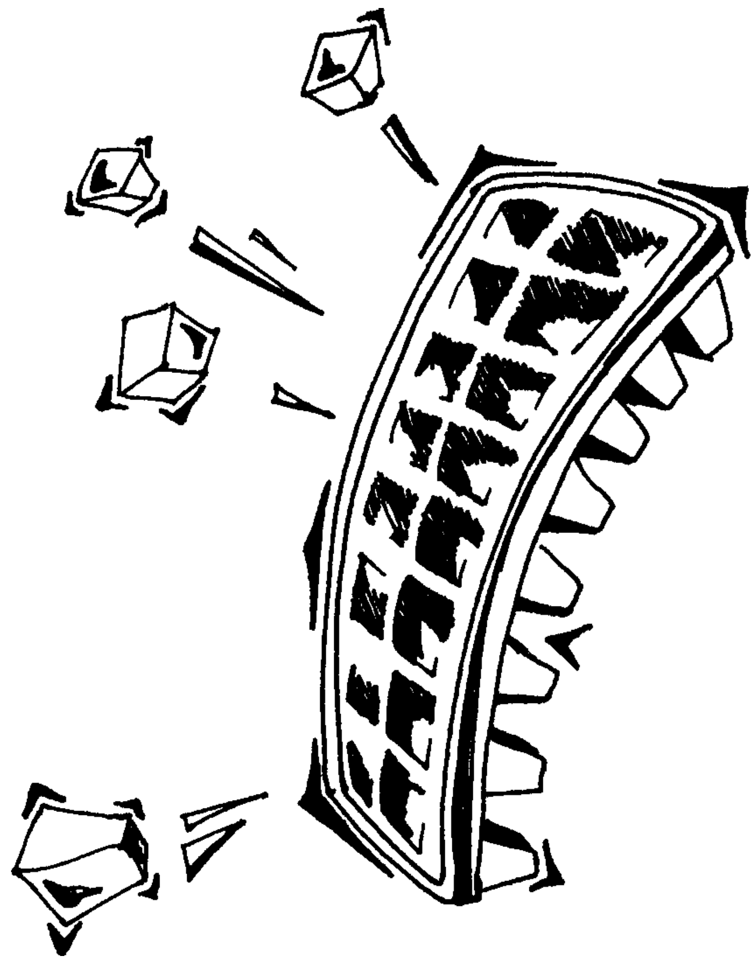
3. Explain that the class is going to do an experiment to see how well the students make predictions. (Make sure all students have a sheet of graph paper.) Instruct students to draw a graph on graph paper like the one shown below. Put a similar graph on the chalkboard.



4. Place the three glasses on a desktop or shelf in plain view of the class. Explain that you are going to put the same amount of ice in each glass. (*Do not do it yet*.) Explain that the ice will be surrounded by water in glass #1, by another container in glass #2, and by air in glass #3.

5. (Group students in teams if you prefer.) Ask the students to predict how long it will take the ice in each glass to melt (completely). Ask them to mark their predictions on the graph. (Glass #1 will have the water, glass #2 the plastic cup, and glass #3 the ice cubes alone.) In addition, have them write a hypothesis (basis for their reasoning) for each prediction (next to the graph or on another sheet of paper).

6. Explain that you will be checking their predictions and hypotheses in 5 minutes. Explain that they will have an opportunity to revise their predictions and hypotheses, if necessary, at that time. Call on a number of students to share their initial predictions with the class. Record them on the graph on the chalkboard.



7. Now put three ice cubes in glasses #1 and #3. Put the same amount of ice in the plastic cup and put it into glass #2. Pour water into glass #1 to fill it half full.

8. In the 5-minute interval, have students discuss the predictions shown on the chalkboard. Do they cluster? Do they differ widely? Why? Ask students to share their hypotheses—how they arrived at their predictions. Then ask if predictions or forecasts, like the examples on the chalkboard, are always right. If not, what is the value in making predictions? How do the students think forecasters—weather forecasters, for example—learn to make accurate predictions? (The discussion should point out that accurate weather forecasts result from forecasters' understanding of the scientific principles involved in weather and learning from their mistakes—analyzing the results of one prediction, making adjustments, and making another, more informed prediction.)

9. After five minutes, have students examine the three glasses. Did the ice melt in any of the glasses? If not, in which glass has the ice melted the most? Have the students participate in checking the predictions recorded on the chalkboard against the results at this point. Did anyone make an accurate prediction? How many students are on the

right track in terms of choosing the glass in which the ice will melt the fastest?

10. Ask students to revise their predictions and hypotheses. Have them record their new predictions and hypotheses on the same graph. (Make sure they mark which is the second prediction.)

11. Ask students to share their revised predictions (record these on the graph on the chalkboard) and what they considered in revising the predictions.

12. Have students examine the new set of predictions recorded on the graph on the chalkboard. Is the pattern generally the same or different than before? Ask students what conclusions they can draw about the process for making predictions from this exercise?

SUGGESTED EXTENSIONS (OPTIONAL)

- Repeat the experiment on another day, but divide the class in half and add a variable (the addition of heat). Duplicate the original setup of glasses for each half of the class and have each group select a student to participate in the experiment. Explain that one group will use a hair dyer to blow warm air at the side of the glasses. The other group will use a hair dryer to blow warm air down from above the glasses. Have each group discuss and arrive at predictions about the ice in the other group's glasses. Remind everyone to consider what happened in the first set of trials. During the 5-minute interval, encourage students to share their predictions (record them on the chalkboard) and discuss how the heat variable affected their hypotheses. When the time has passed, examine the results and discuss what students observed, what conclusions they can draw, and how they would use that information in revising their predictions.

SUGGESTED READING

Cosgrove, Brian. *Eyewitness Books: Weather*. New York: Alfred A. Knopf (1991).

Gibbons, Gail. *Weather Forecasting*. New York: Chelsea House Publishers (1992).

Root-Bernstein, Robert. "Future Imperfect (Incomplete Models of Nature Guarantees All Predictions Are Unreliable)." *Discover*, 14 (November 1993) p. 42.